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A TUMBLER DRYER FOR FLY PUPAE[1/]

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In rearing species of Diptera in the laboratory, a technique of agitation and flotation in water is often used to separate pupae from the larval medium. Therefore, a method of drying and separating the pupae before they are moved to emergence cages is required. Most workers spread the pupae on paper toweling to air-dry or place them and accompanying debris on a screen wire surface and force air past the pupae with a fan.

At the Livestock Insects Investigations Laboratory in Kerrville, Tex., air-drying on paper toweling was used while the technique of mass rearing the horn fly, Haematobia irritans (L.), was being developed. However, the technique required too much bench space and technician time. Also, the pupae of a small dipterous insect-contaminant were invariably carried over with the horn fly pupae and perpetuated. Later, as the colony of horn flies expanded, refinements in technique became possible. One such refinement that appears to have useful application in other laboratories is the tumbler dryer described in this report. We used this dryer with horn flies and have also modified it for the drying of pupae of the stable fly, Stomoxys calcitrans (L.).

MATERIALS REQUIRED

(1) One baseboard, 15 by 6 by 3/4 inches.
(2) One motor-support baseboard, 6 by $3\frac{1}{2}$ by $1\frac{1}{2}$ inches.
(3) One motor-support facing board, 6 by 5-3/4 by 3/4 inches.
(4) One sheet-steel tumbler support, 20 by 6 by 1/8 inches.
(5) One 1/70 hp., 7 r.p.m. gear motor.
(6) One metal tubing (pipe), 3/8-inch inside diameter (ID) by $1\frac{1}{2}$ inches.
(7) One piece rubber tubing, $\frac{1}{4}$-inch ID by $1\frac{1}{2}$ inches.

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(8) Two wood disks, 6-inch diameter by 3/4 inch.
(9) Two steelplates, $1\frac{1}{2}$ by $1\frac{1}{2}$ by 1/8 inches.
(10) Two iron rods, $1\frac{1}{2}$ by $\frac{1}{4}$ inches.
(11) One iron rod, 1 by $\frac{1}{4}$ inch.
(12) One wood dowel, 7 by 3/4 inches.
(13) One piece 20- by 20-mesh plastic screening, 7 by 19 inches.
(14) One wire rod, 28 by 1/8 inches.
(15) One piece muslin, medium weight cotton, 28 by 20 inches.
(16) One electric cord and on-off switch.
(17) Two cap lugs, No. 15.
(18) One electric fan, 10-inch, rubber bladed.

CONSTRUCTION

Fasten motor support baseboard (fig. 1, B) to the top surface at one end of the baseboard (A) with nails or screws. Secure motor-support facing board (C) to A and B as shown in figure 1. Bend sheet-steel tumbler support

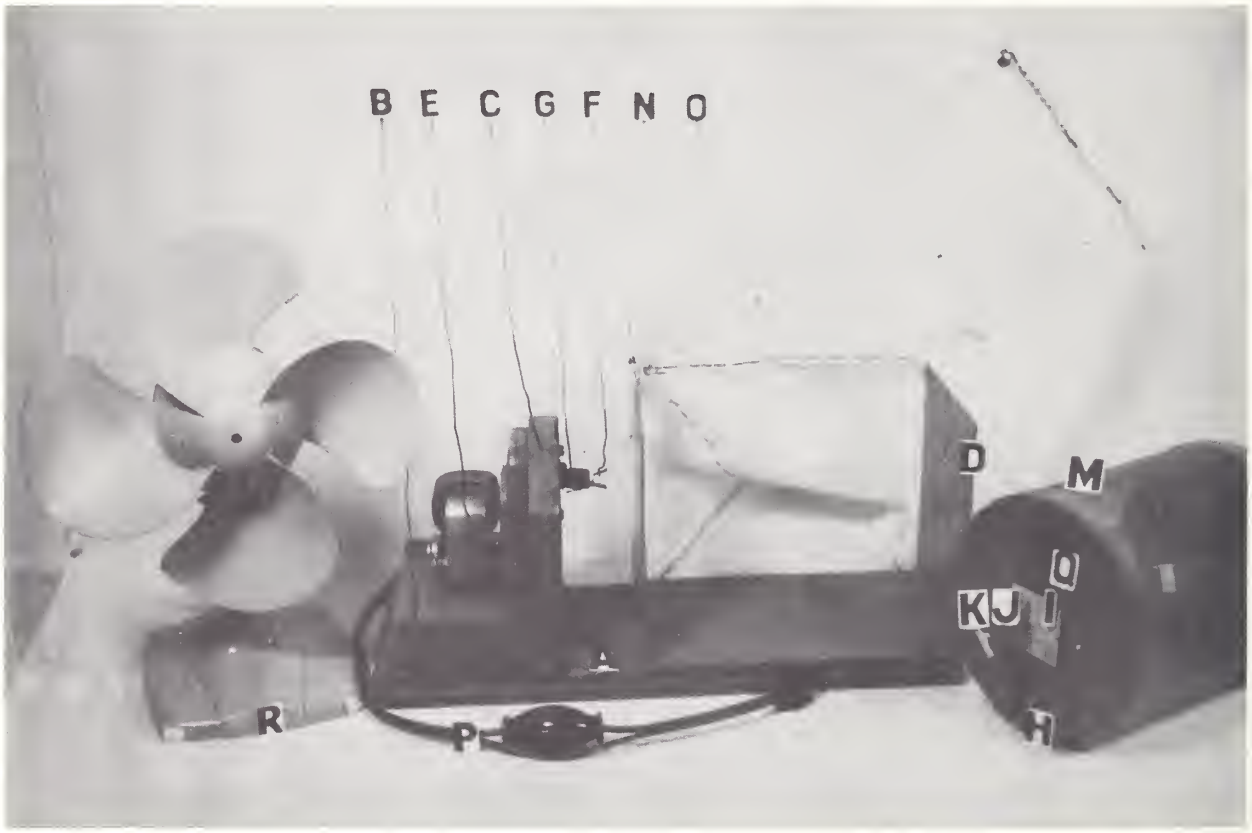

Figure 1.--Identification of parts of a dryer for horn fly pupae. (A) Baseboard; (B) motor-support baseboard; (C) motor-support facing board; (D) sheet-steel tumbler support; (E) gear motor; (F) metal tubing (pipe); (G) rubber tubing; (H) wooden disk; (I) steelplate; (J) iron rod; (K) iron rod; (L) wooden dowel; (M) plastic screening; (N) wire rod; (O) muslin; (P) electric cord and on-off switch; (Q) cap lug; and (R) electric fan.

material (D) at a 90° angle, 6 inches from each end, to form a 6- by 8- by 6-inch ⊔-shaped support, and cut a 2- by $\frac{1}{4}$-inch groove at the midpoint of each upright end to seat the tumbler shaft bearings. Secure the tumbler support to the baseboard at the end farthest from the motor supports.

Drill holes of the correct size in the motor-support facing board and position them to accept the motor shaft and the bolts that secure the gear motor to the facing board. Care must be taken to aline the bearing surfaces of the motor shaft and the tumbler shaft. Cut a 5/16-inch-wide notch in one end of the metal tube (F) to a depth of $\frac{1}{4}$ inch, and then slip F over the end of the motor shaft like a sleeve and secure it to the shaft with the rubber tube (G). The rubber tube and sleeve provide a flexible joint to compensate for small errors of alinement.

To assemble the tumbler, drill a 3/4-inch hole in the exact center of each wooden disk (H) and a $1\frac{1}{4}$-inch hole as near the disk margin as possible without breaking through the margin. Press one disk on each end of the wooden dowel (L). At the center of each steelplate (I), weld one of the iron rods (J) perpendicularly, and then weld an iron rod (K) across the tip of another iron rod (J) to form a "T". The crossbar of the "T" is the contact surface that meshes with the groove in the motor shaft sleeve (F). One of these plate and rod units is secured to the exact center of each disk and serves as a shaft for the tumbler.

Staple and glue the plastic screening (M) to the edges of the wooden disks to enclose the tumbler. With nitrocellulose adhesive, glue together the raw edges of the screening where they overlap. Press the cap lugs (Q) into the disk exits.

To trap the debris lost from the tumbler, sew a muslin, cone-shaped bag (O), and attach it to a 6- by 8-inch wire frame formed from a wire rod (N). Secure the frame to the margin of the tumbler support by type or other easily removable fastenings.

OPERATION

Separate the pupae from the larval medium by agitation and flotation. Skim them from the water's surface with a small piece of screen wire or a sieve, and transfer them to the tumbler dryer through one of the $1\frac{1}{4}$-inch holes. Close the hole with a cap lug, and place the tumbler in the tumbler support so that one tumbler shaft contacts the bearing surface of each tumbler support and the T-bar at the end of the shaft engages the sleeve groove. Place the dryer perpendicular to and 12 to 16 inches from the electric fan (R), and then turn on the tumbler and fan motors as shown in figure 2.

As the pupae and debris dry, particles of debris and small pupae, for example, those of a gnat, pass through the mesh of the screening and are blown into the muslin bag. Drying time varies with the quantity of material, but it is generally less than 1 hour for as much as 100 grams. After the pupae are dry, turn the motors off, remove the tumbler from its support, and pour the pupae through one of the exit holes into a suitable holding container. Adult emergence is not adversely affected by the tumbling.

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The tumbler was modified for drying stable fly pupae by increasing its length to 10 inches and adjusting the baseboard and tumbler support to accommodate the larger tumbler. In addition, 14- by 18-mesh plastic screening was used to cover the tumbler to allow larger particles to escape (fig. 2). A similar dryer would no doubt be suitable for house flies, *Musca domestica* L.

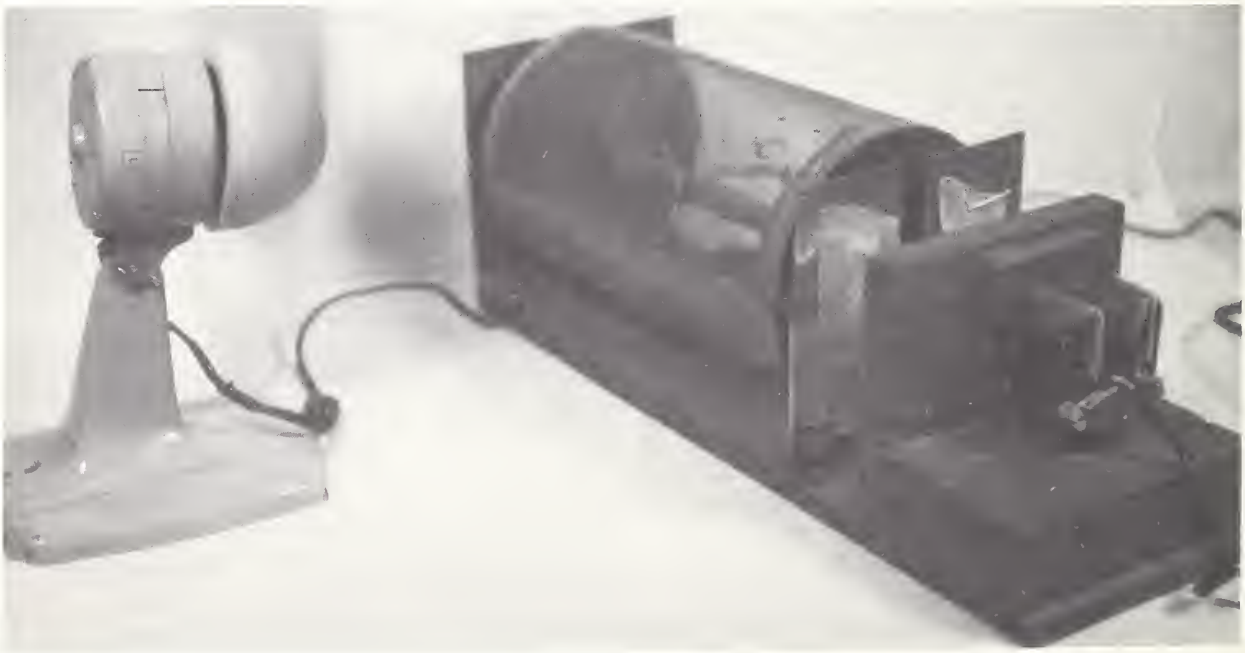

Figure 2.--Dryer for stable fly in operation.